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**The Role of Knowledge in Alliances: A Meta-Analysis**

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## **The Role of Knowledge in Alliances: A Meta-Analysis**

### *Abstract*

Strategic alliances promise an effective means for companies to fill critical gaps and gain position of competitive advantage. A majority of executives believe alliance represent a prime vehicle for future growth, and alliance are expected to account for an increasing percentage of company value. Yet despite the prevalence of alliances, estimates are that up to 75 percent fail. We investigate, using meta-analytic technique, underlying factors that lead to alliance success. We find that the role of knowledge is a significant predictor of alliance success. We also find that cohesion and environmental uncertainty are important moderators.

## **The Role of Knowledge in Alliances: A Meta-Analysis**

### **I. Introduction**

They account for 6-15% of the market value for the typical company (Kalmbach and Roussel 1999). The 100 largest generate more than \$350B in annual revenue (Bamford et al. 2004). They generate economies of scale, increase profits, and grant firms the ability to storm new markets (Moyer 2004). In the year 2000 alone, over 10,000 appeared (Schiffrin 2001a; Schiffrin 2001b). Executives tout them as a prime vehicle for future growth (Kalmbach and Roussel 1999). What are these business wonders? They are alliances.

Alliances are big business. They fill critical resource gaps and endow firms with competitive advantages in the marketplace (Day 1995; Lambe et al. 2002; Sivadas and Dwyer 2000). According to estimates, firms with \$2 billion or more in revenues developed an average of 138 alliances between 1996 and 1999 (Schiffrin 2001a; Schiffrin 2001b). But there is one problem with alliances: up to 75% of them fail (Day 1995; Liker and Choi 2004). Managers understand the important benefits of alliances, but they do not understand what makes an alliance succeed.

The underlying assumption of this meta-analysis is that the role of knowledge underlies the reason why firms enter into alliances in the first place (Varadarajan and Cunningham 1995). Indeed, numerous studies refer to knowledge as the primary objective behind alliance participation (Grant and Baden-Fuller 2004; Moorman 1995; Moorman and Miner 1997; Nielsen 2003; Rindfleisch and Moorman 2001; Simonin 1999). Despite a general acceptance of the importance of the role of knowledge, findings vary widely, with little or no consensus on its relationship to the successful performance of strategic alliances (Teece 1998). The body of literature has reached the point that a meta-analysis seems timely to evaluate the evidence with

regard to statistical significance and magnitude of effects for the performance implications of the roles of knowledge and their moderators in alliance research.

Two objectives motivate this study. First, this study seeks to demonstrate that alliance performance is influenced by the role that knowledge plays in the alliance. Second, this study provides valuable insight into some important factors that moderate the successful use of knowledge by alliances. Meeting these objectives ought to cast new light on the interaction of relational norms versus the industry structure and knowledge as a resource paradigms of alliance performance (Dyer and Singh 1998). We begin with a literature review of the roles of knowledge-use by alliances and the possible moderators of knowledge's role on alliance performance. Then we give a brief overview of the appropriateness of meta-analysis for resolving conflicting findings as well as assessing the relative importance of different independent variables. We present the methodology for identifying studies to include in the meta-analysis, and then end the paper with a discussion of the implications of the findings, limitations, and possible avenues for future research.

## **II. Literature Review: Definitions and Constructs**

One of the most important trends currently taking place is the increasing cooperation between firms (Grant and Baden-Fuller 2004). Alliances cover a wide range of collaborative activities including supplier-buyer partnerships, joint marketing, shared new product development, shared manufacturing arrangements, common distribution agreements, and franchising (Grant and Baden-Fuller 2004; Varadarajan and Cunningham 1995). Firms entering an alliance relationship trade dependency for access to important resources and the attainment of a common goal (Teece 1992). The alliance knowledge literature draws extensively upon the

resource-based view of the firm (Barney 1991), Prahalad and Hamel's (1990) competence-based view, and Grant's (1996) knowledge-based theory of the firm. These and other past works inspired the conceptual model for this meta-analysis (see Figure 1).

### *Roles of Knowledge*

Alliances play a key role in re-distributing asymmetric skills and resources between firms (Hamel 1991). Some research supports the performance benefits to firms able to transfer knowledge from other organizations (Almeida and Kogut 1999; Inkpen and Tsang 2005). Other research has emphasized the benefits of knowledge-based competitive advantages, generally based upon causal ambiguity (McEvily and Chakravarthy 2002; Reed and DeFillipi 1990; Simonin 1999; Zander and Kogut 1995). However, empirical support for the knowledge-performance link remains scarce in the literature (Teece 1998).

Among extant examples of the performance-enhancing benefits of interfirm knowledge transfers, a few stand out. In the logistics literature, information processing has been cited as critical to efficiency and effectiveness (Bowersox et al. 2000). In the management literature, Hult, et al. (2004), proposed a model relating achieved memory, knowledge acquisition, information distribution and shared meaning to cycle time. Each of these three constructs offers a different perspective on the role of knowledge in relation to business improvement. Achieved memory provides a guide to the other information processes in the organization, a background or frame of reference for collective action. Knowledge acquisition activities convert experience and other gathered knowledge, often focused on certain areas, in order to direct firm resources (Huber 1991). Information distribution activities benefit from strong organizational cultures and communication media to transmit needed information and speed interactions (Kohli and

Jaworski 1990; Narver and Slater 1990). In all these cases, knowledge serves to enhance business performance. Therefore, we propose the following hypothesis:

*H<sub>1</sub>: An aggregate measure of knowledge will positively relate to alliance performance.*

### *Knowledge Generation.*

Drawing upon the information acquisition views of Rindfleisch and Moorman (2001), our view of knowledge generation focuses on the acquisition of information directly pertinent to development of new products or services. Intra-firm knowledge generation has received general support in the marketing literature for contributing to firm growth and success (Andrews and Smith 1996; Sethi et al. 2001). Research has also supported knowledge generation's effectiveness at developing new products in the interfirm context (Im and Workman 2004; Rindfleisch and Moorman 2001; Sivadas and Dwyer 2000).

Alliances provide a primary vehicle for interfirm interactions that lead to innovation generation (Nielsen 2005; Roy et al. 2004). Alliances have been called "...the most important source of new ideas and information that result in performance-enhancing technology and innovations" (Dyer and Singh 1998, p. 665). Unfortunately, the requirements for innovativeness include flexibility and departures from planned objectives, factors that destabilize alliances (Sivadas and Dwyer 2000). This may partially explain the high failure rate for alliances.

Nevertheless, empirical studies of alliances in industries that depend on innovation for success indicate that members of alliances that do survive outperform firms that lack innovative partners (Stuart 2000). Furthermore, the more complex and tacit the knowledge required for the innovation, the greater the advantage of the alliance relationship (McEvily and Chakravarthy 2002). The aforementioned conceptual and empirical works lead us to propose that:



*H<sub>2</sub>: Alliance knowledge generation will relate positively to alliance performance.*

### *Knowledge Sharing*

Sharing of knowledge refers to the accessibility of know-how and information between organizations (Appleyard 1996). Conceptually, knowledge sharing will be present in many instances of organizational learning, but forms a distinct inter-firm process (Appleyard 1996; Roper and Crone 2003). Its essence consists of knowledge redundancy in terms of innovation and skills, but the sharing of resources that permit information utilization (Rindfleisch and Moorman 2001). Teaming for the purposes of setting standards or tracking industry trends, such as SEMATECH for the semiconductor industry, is an example of a knowledge sharing alliance. Firms involved in knowledge sharing alliances generally consist of horizontal alliances seeking to reduce environmental uncertainty (Bucklin and Sengupta 1993). Dyer and Singh's conceptualization of information sharing clearly approximates this study's concept of knowledge sharing (Dyer and Singh 1998).

Various phrased knowledge transfer or interfirm learning, knowledge sharing entails sharing of information systems, resources, competencies, personnel and other knowledge resources already possessed by at least one alliance member but not by at least one other (Baker and Sinkula 1999). Uses of knowledge sharing include the sharing of complementary knowledge resources that lead to competitive advantage or sharing of information on supplier and customer markets. Research has linked sharing of knowledge at the organization level with higher short-term financial benefit (Moorman and Miner 1997). This leads to the following hypothesis:

*H<sub>3</sub>: Alliance knowledge sharing will positively relate to alliance performance.*

*Knowledge Implementation*

Knowledge implementation occurs when generating or sharing knowledge becomes difficult, expensive or time-consuming. Those implicit and explicit costs prompt one alliance partner's desire to allow a trusted partner to perform certain tasks (Kogut and Zander 1992). Firms do not merely share knowledge, nor do they seek to create new knowledge; rather, each firm adds value through its specialized knowledge or capability. Many modern products and services are the result of complex combinations of many skills and technologies, making it impossible for a single company to maintain specialized knowledge in all of them. Knowledge implementation alliances rely on integrating systems to win over customers (Varadarajan and Cunningham 1995).

Knowledge implementation alliances commonly crop up in the logistics and supply chain literature, benefiting members by improving execution or combining common production expertise in order to garner the benefits of risk pooling and reduced investment in additional production capacity (Roper and Crone 2003). These types of alliances generally seek improved efficiencies rather than new knowledge. However, they do so with no intention of gaining another firm's knowledge but rather retain compartmentalization of knowledge in the alliance. Knowledge implementation relies on different abilities created by blending capabilities of different alliance member firms (Kogut and Zander 1992). Component capabilities at the firm level make possible architectural capabilities at the interfirm level (Henderson and Clark 1990; Henderson and Cockburn 1994). This allows improved economies of scale and competence at the firm level while leveraging the broader capabilities throughout the alliance. This leads us to propose:

*H<sub>4</sub>: Alliance knowledge implementation relates positively with alliance performance.*

### *Alliance Cohesion*

In the alliance knowledge literature, Hamel described the concepts of internalizing versus merely accessing knowledge (Hamel 1991). A *collaborative membrane* functions 1) as a filter between organizations in an alliance, and 2) to determine what kind and in which direction knowledge will flow. The collaborative membrane thereby defines the *collaborative exchange* between alliance members. In the context of our model, the concept of the collaborative membrane determines the *cohesion* of an alliance network.

Alliance cohesion refers to the degree of trust and cooperation that results from norms created by the interactions of the alliance partners. The strength-of-ties perspective parallels the concept of alliance cohesion (Rindfleisch and Moorman 2001). Cohesion facilitates coordination and the sharing of information and other resources and opportunities (Gargiulo and Benassi 2000). Alliances depend on regular interaction to work. Alliance members that do not regularly interact lack the knowledge or ability to enforce norms against another member (Coleman 1988). This viewpoint finds support in the strength-of-ties literature (Rindfleisch and Moorman 2001).

In accordance with Kahn's (1996) work on integration, collaboration denotes continuous interaction, usually of an informal nature, without a clearly defined structure. Collaboration attempts to achieve collective goals by sharing resources and a common vision. Collaboration offers advantages for organizations in highly unstable environments by buffering volatility which, in turn, enhances learning-by-doing (Sorenson 2003).

In contrast, modularization is an architecture of discrete nodes or clusters held together by standards of performance and conformance to design rules (Langlois 2002). Such arrangements lower transaction costs while preserving the separate identities of the firms

involved (Kahn 1996). Ethiraj and Levinthal (2004) revealed that modularity results in improved speed and efficiency through redundant parallel operations by several network members. This reduces idle time, leading to more work done in the same amount of time compared to operations all being conducted by one firm. Products of limited diversity with independent markets for each of the modules (such as computer memory) tend to benefit greatly from the recombination possibilities of modularity. Operations requiring more complex interactions, such as testing and integrating new product innovations, bring to light the difficulties of optimizing highly interdependent processes in a modular network (Ethiraj and Levinthal 2004). Products involving highly complex interdependencies of design and manufacture, or heterogeneity in available design choices (such as a microprocessor), tend to benefit more from integration.

The moderating effect of cohesion will interact differently with different forms of knowledge. However, both modularity and integration work well in the appropriate environment. Therefore, we propose:

*H<sub>5</sub>: Combined measures of both collaborative and modular cohesion will positively moderate the relationship between knowledge and alliance performance.*

#### *Environmental Risk*

Studies on the impact of the firm's environment on firm performance abound throughout the marketing and alliance literatures. One important cause of environmental risk is the rate of technological turnover (Bucklin and Sengupta 1993). Market uncertainty represents another source of environmental risk (Dahlstrom et al. 1996; Varadarajan and Cunningham 1995). The extent of competition and market development stage constitute other specific environmental risk factors (Gulati 1998). The regulatory environments present other important factors that may

increase environmental risk (Varadarajan and Cunningham 1995) or decrease risk by creating a supportive legal institution (Li and Atuahene-Gima 2002).

The environment also inspires managerial responses, including the development of complex knowledge structures to combat risk (McNamara et al. 2002). Empirical studies indicate that alliances perform better in turbulent environments (Bucklin and Sengupta 1993). Alliances provide a means of spreading risk and of rapidly assimilating capabilities required to effectively deal with uncertainty (Varadarajan and Cunningham 1995). However, the presence of environmental risk diminishes potential opportunities. This leads to a complex interaction between the benefits of knowledge garnered through alliance relationships and the ability to realize performance enhancements. Therefore,

*H<sub>6</sub>: Alliance environmental risk will moderate the relationship between all roles of knowledge and alliance performance.*

### *Alliance Performance*

Alliance performance measures vary with the purpose of the alliance. Studies of alliance new product innovations usually measure new product success or knowledge transfer (Rindfleisch and Moorman 2001; Sivadas and Dwyer 2000). Other studies measure some aspect of the alliance itself, such as partner trust or duration (Geringer and Herbert 1991; Yan and Zeng 1999). Other studies have focused on business performance measures such as market share or profits (Geringer and Herbert 1991; Singh and Mitchell 2005). Lastly, some studies measure an overall assessment of alliance satisfaction (Dahlstrom et al. 1996; Lin and Germain 1998; Parkhe 1993).

A study by Ariño has assessed the validity of alliance performance constructs, finding strongest support for the validity of outcome and process measures with weak validity findings

for financial and measures of some aspect of the alliance itself (Ariño 2003). Outcome performance focused on degree of accomplishment of alliance goals, and process performance dealt with the acceptability of interactions to alliance partners. This suggests that studies measure alliance performance will impact the magnitude of their results. This is an issue dealt with in the data entry and analysis sections of this meta-analysis.

### **III. Method**

#### *Meta-Analysis Issues*

Meta-analysis presents two unique challenges to conventional analytical techniques. The first challenge follows from the impossibility of directly testing effect consistencies across studies. The second issue is the violation of the assumption of homoscedasticity in variance. The first issue results from the lack of a conventional statistical test for interactions at the treatment-by-study level (Hedges and Olkin 1985). The second results from differences in non-systematic variances across studies due to different sample sizes and the existence of different groups within each study.

Researchers have developed specialized techniques that correct for sample size and the different error across studies. Lipsey and Wilson detail the meta-analytic techniques for determining effect sizes, performing differences between groups, and linear regression models (Lipsey and Wilson 2001). The techniques described below mirror the guidance provided by Lipsey and Wilson.

The first step in meta-analysis of study results entails conversion of study variables into *effect sizes*. Much like z-scores used in other analyses or standardized scores used in a variety of tests, effect sizes represent study results on a scale that standardizes the variance across studies in

order to compare variables and measures. Based on the assumption of a single underlying population, effect sizes form a basis for calculating means, correlations, variances, and other analytical statistics. Table 1 presents “rule of thumb” values for correlation effect size ranges that will be used later in this study (Lipsey and Wilson 2001, p. 147).

To compare systematic variance across studies based on a categorical variable, an analog to the ANOVA can be employed to compare variability between group means to variability within groups. An analog ANOVA performs the same function as an ANOVA. However, the method uses the homogeneity  $Q$  statistic as the total inter-study variance divided into between and within group variance based on inverse variance weights, and degrees of freedom based on the number of effect sizes. Standard errors and confidence intervals around the weighted mean effect size comprise the basis for the analog ANOVA results.

### *Sample Development*

To reduce concerns about the quality of studies included in this meta-analysis, only studies from a select group of high quality journals from 1984 to September of 2005 were included. Table 2 lists the ten journals evaluated as sources of alliance studies. Additionally, the research files of a university professor who studies alliances were included. The review totaled 219 articles from the listed journals and another 39 from the professor for a total of 258 articles. A total of twenty-four studies (listed in the Appendix) met the criteria for inclusion in this meta-analysis, returning 113 effects. After taking the average of the effect sizes for the same constructs within each study, a total of 65 mean effect sizes constitute the data for this meta-analysis. Most excluded studies failed to include the variables of interest. Others were excluded because they did not provide correlations or data amenable to analysis.

Transforming statistics to correlations offers one option for including additional studies. Though methods exist for performing transformations of other statistics to correlation effect sizes, experts suggest "...it is not generally appropriate to combine study findings derived from different research designs and appearing in different statistical forms, even if they deal with the same topic" (Lipsey and Wilson 2001, p. 2). Consequently, only data from studies that included Pearson's product-moment correlation coefficients appear in this meta-analysis. This greatly reduced the data eligible for this study, but reduced doubts about the quality of the data.

We corrected for measurement error by dividing all correlations by the square root of the reliabilities of the correlated constructs. Average construct reliabilities were substituted for missing values (Geyskens et al. 1999; Kirca et al. 2005; Lipsey and Wilson 2001). The corrected correlations were then converted to Fisher-z values as the last step in standardization, averaging multiple representations of a construct where more than one appeared in a study. The SPSS macros provided by Wilson (Wilson 2002) weighted each effect by the inverse of the variance ( $n-3$ ) and performed mean effect size, analog ANOVA, and meta-analysis weighted regression.

#### **IV. Analysis**

##### *Analog ANOVAs of Model Constructs*

Calculations for a fixed effects model appear in Table 3 and for random effects appear in Table 4. All effect sizes demonstrate significance (95% confidence interval does not include zero and  $p < 0.05$ ) with the exception of negative environment in the random effects model, which is marginal. All tests of homogeneity indicate that the effect sizes do not all estimate the same effect size. This supports the thesis that systematic differences influence the relationship between the role of knowledge and alliance performance.



None of the effect sizes surpasses large magnitudes ( $r \geq 0.40$ ). However, based upon the guidance of  $r = 0.25$ , cohesion and knowledge exhibit solid medium effect sizes for both the fixed and random effects models (fixed effects  $r = 0.2998$  and  $r = 0.3154$ , respectively, and random effects  $r = 0.3305$  and  $r = 0.2473$ , respectively). Environmental uncertainty exhibits small but statistically significant effect sizes, revealing  $r = -0.0623$  and  $r = -0.1166$  respectively for the fixed and random effects models.

Calculations of analog to the ANOVA models reveal some interesting insights into construct validity. Table 5 portrays the analog to the ANOVA results for the fixed effects models. Fixed effects models assume each study will measure the exact same effect size (Mosteller and Colditz 1996). Extant literature suggests that heterogeneous within groups variance (a low  $p$ -value) requires a mixed model considering not only systematic and subject-level sampling error but the random effect in the effect size distribution as well (Lipsey and Wilson 2001). Mixed effects models provide appropriate, conservative measures in the case of exploratory research with constructs or samples characterized by uncertainty (Overton 1998). Based upon these theoretical considerations and the statistically significant within-groups and between-groups variances in the fixed effects analog ANOVAs, a mixed effects model seemed most appropriate for further analog ANOVA analysis.

Table 6 contains the analog to the ANOVA results for the mixed effects models. Based upon the analog ANOVA results and the confidence intervals in Table 4, the cohesion and knowledge constructs exhibit statistically significant non-zero effect sizes on alliance performance. This finding supports  $H_1$ .

The knowledge constructs provide interesting insights into the role of knowledge on resulting alliance performance. Firstly, knowledge at the aggregate and component levels

demonstrates a solid medium correlation effect size on performance (Table 4), providing additional support for H<sub>1</sub>. Secondly, the generation and implementation roles of knowledge exhibit statistically and practically significant effect sizes, thereby providing evidence that supports H<sub>2</sub> and H<sub>4</sub>. The analog ANOVA indicates a statistically significant but low magnitude mean effect size for knowledge sharing, thus failing to support H<sub>3</sub>. The wide spread of mean effect size values for knowledge sharing indicates, perhaps, a less certain path to alliance success. This also indicates that possibly generation and implementation produce the same results in terms of alliance performance. Table 7 portrays the results of an analog ANOVA with generation and implementation grouped together vs. knowledge sharing; the non-significant between groups variance indicate insufficient evidence to analyze knowledge sharing as a separate construct.

The mean effect size for the combined cohesion construct demonstrates a statistically significant relationship with alliance performance. Additionally, at the component level, collaborative and modular cohesion also demonstrates statistical significance. These findings provide evidence to support H<sub>5</sub>.

Environment did not exhibit a statistically significant mean effect size on alliance performance, failing to support H<sub>6</sub>. Several different factors may account for this counter-intuitive finding. Of the 65 effects in this meta-analysis, only 13 measured environmental factors, only about half the representation of knowledge role and cohesion constructs. If one assumes that different environmental factors have different influences on alliance performance, one must accept that either the environmental factors are such a common precursor to alliance formation as to render the construct indiscriminant in relation to alliance performance. Or,

alternatively, there is a problem with the measurement of correlations of environmental factors with alliance performance.

#### *Analog ANOVAs of Study Differences*

Study differences were dummy coded and analyzed for country, US vs. non-US, performance measure, industry, perspective, alliance type, and specification. Ordinary least squares analog ANOVAs revealed significant within group variance, indicating heterogeneous effect size distributions. These results led to the use of a mixed effects model for the analyses of study differences (Lipsey and Wilson 2001; Mosteller and Colditz 1996; Overton 1998).

With regard to performance measures, studies were coded as assessing performance as outcome, process, longevity, or financial. Outcome and process definitions derived from the Ariño study, as described in the literature review (Ariño 2003). Longevity referred to the duration of the alliance in years. Financial referred to any measures based on monetary value (e.g., sales, revenues). As hypothesized, ANOVA revealed that process and outcome performance measures correlated with a medium effect size but that longevity and financial measures did not achieve a significant difference from zero (see Table 8).

The industry dimension consisted of high tech, manufacturing, services, or mixed categories. A significant between groups  $Q$  and non-significant within groups  $Q$  indicate that industry has a significant effect size for correlations with alliance performance (see Table 9). Breaking out the effect sizes by group reveals that services have the strongest correlation effect size with alliance performance, on the verge of a large effect size (based upon previously stated guidance of  $r \geq 0.40$ ), followed by manufacturing with a medium effect size. The mixed category falls a little below manufacturing and logically enough seems to be an average of the

other three categories. Interestingly, high tech industries evidence a weak correlation effect size; this could result from the prevalence of alliances in high tech industries, making alliances the price of entry rather than a competitive advantage.

The analog ANOVA of the sample's perspective (buyer, supplier, dyad, or mixed) resulted in insignificant between groups variance, but healthy within groups variance (see Table 10). Looking at the effect sizes by group, it appears that samples that specified buyers, suppliers, dyads, or peers have significant effect sizes. The studies that did not specify a sample perspective returned a lower mean effect size that was not statistically significant.

Coding studies by alliance type (partnership, joint venture, collaboration, or mixed) returned a significant analog ANOVA model (see Table 11). Alliance study samples categorized as collaboration returned the highest effect size--0.5415--though based on a sample of only four. However, partnerships returned a zero mean effect size; though based on a small sample ( $N=3$ ), the wide-ranging results of this analog ANOVA analysis indicates that alliance type should be included in future alliance studies of knowledge and alliance performance.

The study's theoretical specification (whether oriented toward alliance formation, on-going alliance, or new product development alliance), returned a statistically significant analog ANOVA model (see Table 12). The model seems to ride on the strength of the on-going alliance group of studies since neither the alliance formation nor the new product development studies demonstrate statistically significant group effect sizes. This seems theoretically sound since alliances imply long-term relationships. Alliance formation studies would include alliances that have had too little time to develop and benefit members; new product development studies would include alliances either short-term in nature, or simply too narrow to provide a strong correlation with alliance performance.

A weighted regression analysis of study effects revealed some interesting insights. A backward stepwise regression process using the mixed effects model based on maximum likelihood estimation supports the importance of the relationship between industry, alliance type and alliance performance. Separate analyses including and excluding a dummy variable for the model's constructs both implicated the importance of industry and alliance type to study results (see Table 13 and Table 14). With the model's constructs included, the  $R^2$  of 0.3616 implies that inclusion of industry and alliance type in study design influenced the study's findings with medium strength regression coefficients of 0.1447 and 0.1449, respectively.

#### **VI. The Role of Knowledge in Alliances: New Insights**

This meta-analysis represents is an exploratory foray into a vast domain of disparate studies, methods, finding, and statistics dealing with alliance performance. Nevertheless, it provides several key insights, theoretical and practical, regarding the status of the literature on the role of knowledge on alliance performance.

##### *Practitioner Implications*

Practitioners may benefit from several insights from this meta-analysis. First and foremost, less committed alliances that only share knowledge exhibit much lower alliance performance benefits than alliances based upon implementing and generating knowledge. Alliances that integrate processes may provide greater benefits for industries dependent on vertical suppliers or buyers, such as manufacturing and services.

In terms of managing alliances, it appears that outcome-oriented alliance performance measures--followed closely by process measures--may provide the greatest benefit in terms of

alliance performance. Managers who measure alliance performance with financials or based upon longevity will likely not see improved alliance performance. This agrees with the market orientation literature that asserts that focusing on outcomes and processes beneficial to the customer will lead to the greatest long-run performance benefits (Jaworski and Kohli 1993; Kirca et al. 2005; Kohli and Jaworski 1990; Narver and Slater 1990; Rindfleisch and Moorman 2003).

It appears that knowledge implementation and knowledge generation have the same magnitude of effect on alliance performance. Implementing knowledge in an alliance setting implies continuous innovation of processes--certainly, alliances that continue to exist successfully imply adaptation on the part of its members. Implementation of knowledge may essentially be knowledge generation--or knowledge generation may simply be implementation of knowledge--casting new light on the importance of knowledge management in alliances. Recent qualitative research in an industry characterized by alliances (logistics) suggests that the motivation of the alliance members and the value expected from social interaction may lead to more successful collaborative endeavors than those relationships organized by financial value expectations (Golicic and Mentzer 2005). Other promising research supports the importance of the social dimension to the desirability garnering knowledge from outside organizations at the individual manager level, particularly in organizations that were internally competitive (Menon 2000). Marketing research reinforces the importance of the social aspect of interorganizational relationships to the role of knowledge. The organization's cultural and structural characteristics may, in fact, determine to a great degree how knowledge is utilized (Menon and Varadarajan 1992). In any case, sharing of knowledge appears a less certain path to success.

Study specification reveals that the effects of an alliance take time to come to fruition--new product development and newly formed alliances do not exhibit significant mean effect sizes in their relationships between knowledge and alliance performance. The lack of significance for longevity as a measure of alliance success indicates that successful alliances do not necessarily last longer. Certainly, firms committed to an on-going alliance benefit more from the knowledge interchanges that take place.

Managers should also realize that in highly uncertain environments, alliances might mitigate but do not necessarily stop negative performance consequences. This seems common sensical, but in consideration of the non-significant performance improvement findings for newly formed and new product development alliances, decision-makers considering alliances should consider them as part of a long-term strategy designed to better serve customers. Those seeking immediate succor from changing competitive environments will be disappointed.

### *Theoretical Implications*

The role of knowledge in alliances appears to differ drastically by industry type. Services exhibited a strong relation with effect size, manufacturing somewhat less but still important. Services and manufacturing are both industries that depend on other members of the value chain to contribute to efficiency and efficacy. So these findings may result from the prevalence and importance of vertical alliances in these industries. However, with only four services and five manufacturing studies included in the meta-analysis, these findings require further research to establish more fully their generalizability. Three out of the four service industries interfaced directly with end consumers (construction services, advertising and software agencies, and retail gas service stations) and were international or non-US in scope (Helfert et al. 2002; Nygaard and

Dahlstrom 2002; Sarkar et al. 2001), while the fourth studied the US warehousing service industry (Dahlstrom et al. 1996). The manufacturing studies covered a spectrum of companies and industries in both US and non-US contexts (Dussauge et al. 2004; Heide and John 1990; Joshi and Stump 1999; Kim et al. 2004; Nielsen 1998). High tech industries do not benefit as much from knowledge in alliance relationships, despite the important benefits of learning and having established routines of innovation and production to high tech firm success (Macher and Mowery 2003).

The environmental uncertainty construct revealed the biggest surprise, especially in light of Bucklin and Sengupta's (1993) finding that alliances are more effective in turbulent environments. The lack of significance and low effect size indicate that either research does not address the correct measures of environmental uncertainty, or (perhaps) that environmental uncertainty does not always correlate with alliance performance. For example, industries enjoying relatively low environmental risk, such as cement companies, may still leverage economy of scale advantages from alliances, but do not demonstrate the moderating effect of uncertainty on alliance performance. Alternatively, alliances may successfully mitigate environmental uncertainty enough to diminish a strong correlation with alliance performance.

The non-significant finding for sample perspective may result from the failure of many studies to control for that factor. This could indicate an important dimension missed by many studies--the perceived performance of alliances may depend on the role of the players in the exchange relationships. Alliances may prove more beneficial to suppliers, or when suppliers share risk with their buyers in a close dyad.

In keeping with strength-of-ties literature (Rindfleisch and Moorman 2001; Wuyts et al. 2004), the type of alliance returned highly significant results for collaborative alliances, but weak



results for the most represented alliance type in this meta-analysis, the joint venture. However, many studies do not consider alliance type when assessing the relationship between knowledge and alliance performance.

Current alliance literature lacks well-developed and corroborated constructs, and has yet to assess systematically the validity of extant measures of constructs. One construct whose validity has been studied is alliance performance. This meta-analysis confirms past research into alliance performance outcome construct validity that found weak support for longevity and financial measures as indicators of alliance success, but supported process and outcome dimensions (Ariño 2003).

### *Future Research*

Future research needs to explore the conceptual differences, if any, between knowledge generation and implementation. Conceptually this makes sense from the perspective that merely sharing knowledge implies weaker alliance effects than more integrated operations with alliance partners implied by generating or implementing knowledge. In any case, sharing of knowledge appears a less certain path to success--future research needs to work toward a consensus on the types of knowledge in addition to roles of knowledge.

The importance of environmental antecedents of alliances or their effect on alliance performance constitute an important area little explored by researchers. The ever-changing environment complicates its study, but without comprehending the market environment, theoretical explanations lose power. Alliances in many industries are an important strategy for coping with environmental uncertainty; nevertheless, this meta-analysis found a weak negative effect of uncertainty on alliance performance. Alliances may successfully mitigate

environmental uncertainty enough to diminish a strong correlation with alliance performance, but this requires further investigation.

Related to environment, the influence of industry on knowledge's ability to contribute to alliance performance needs further exploration. Specifically, the non-significant findings for the high tech industry may result from alliance networks comprising the price of entry to this industry, or perhaps from the modular nature of the relationships that characterizes much of the high tech industry, inhibiting the full realization of alliance benefits. Another explanation may reside in the rapidly changing nature of high tech and similar industries--alliance relationships need to change too quickly for them to achieve their full potential, thus diminishing the benefits of knowledge gained through alliances in these industries. The fact that some of the largest high tech firms like Intel, Samsung and Texas Instruments maintain a large part of their capability in-house rather than through partnerships or outsourcing indicates that alliances are not the only strategy for dealing with uncertainty (Carbone 2005). This is an important topic of future research.

### *Conclusion*

Overall, this meta-analysis indicates that the role of knowledge is an important indicator of alliance performance, and that cohesion and environmental uncertainty are important moderators of this relationship. Unfortunately, extant alliance literature lacks standardized measures and sufficient empirical research to conduct a truly thorough meta-analysis of these relationships. This points to the need for researchers to continue to work toward a consensus on the antecedents and consequences of knowledge in alliances.

The lack of sufficient correlations to conduct more detailed weighted regression analyses of the study effects indicates that journals should publish or make accessible study data for replication by other researchers. Alliances impose a large burden on researchers in terms of the large numbers of players as well as the possible antecedents and consequences of alliance performance. The costs levied on researchers to gather this data augment the importance of sharing available data with other researchers. Just as importantly, this study indicates that certain sample characteristics have an impact on alliance performance--the industry studied, the relationship between alliance members, and the type of alliance--yet most researchers either do not gather this information or do not provide it in their published results. Using this meta-analysis as a springboard, researchers can standardize at least the significant variables implicated by this endeavor. Though a meager start, future alliance research would benefit by accounting for some variance and perhaps aiding in future theory development.

**Table 1: Correlation Effect Size Analogous Values**

Small	Medium	Large
$r \leq 0.10$	$r = 0.25$	$r \geq 0.40$

**Table 2: Journals Searched**

*Academy of Management Review*  
*European Business Journal*  
*European Journal of Marketing*  
*European Management Journal*  
*Journal of the Academy of Marketing Science*  
*Journal of Business Logistics*  
*Journal of International Business Studies*  
*Journal of Marketing*  
*Journal of Marketing Research*  
*Strategic Management Journal*

**Table 3: Mean Effect Sizes (Fixed Effects Model)**

	N	Mean ES	SE	-95% CI	+95% CI	p	Q
<i>Cohesion</i>	26	.2998	.0144	.2716	.3280	.0000	316.6868
Collaboration	16	.2827	.0172	.2489	.3164	.0000	166.3579
Modularity	10	.3394	.0261	.2881	.3906	.0000	147.0447
<i>Knowledge</i>	26	.3154	.0076	.3005	.3303	.0000	284.3865
Generation	6	.3508	.0115	.3283	.3733	.0000	24.8993
Implementation	8	.3051	.0112	.2831	.3272	.0000	63.9284
Sharing	12	.2050	.0242	.1575	.2525	.0000	25.9262
<i>Environment</i>	13	-.0623	.0061	-.0744	-.0503	.0000	259.8407
Positive	5	-.0331	.0088	-.0503	-.0159	.0002	25.9262
Negative	8	-.0906	.0086	-.1075	-.0737	.0000	212.0212

**Table 4: Mean Effect Sizes (Random Effects Model)**

	N	Mean ES	SE	-95% CI	+95% CI	p	Q
<i>Cohesion</i>	26	.3305	.0523	.2280	.4331	.0000	316.6868
Collaboration	16	.3455	.0595	.2288	.4621	.0000	166.3579
Modularity	10	.3028	.1065	.0940	.5115	.0045	147.0447
<i>Knowledge</i>	26	.2473	.0330	.1826	.3119	.0000	284.3865
Generation	6	.2923	.0528	.1889	.3958	.0000	24.8993
Implementation	8	.2746	.0624	.1522	.3969	.0000	63.9284
Sharing	12	.1993	.0955	.0122	.3864	.0368	25.9262
<i>Environment</i>	13	-.1166	.0346	-.1844	-.0488	.0007	259.8407
Positive	5	-.0924	.0320	-.1551	-.0296	.0039	25.9262
Negative	8	-.1172	.0622	-.2391	.0047	.0596	212.0212

**Table 5: Analog ANOVA Results (Fixed Effects Model)**

	Between <i>Q</i> ( <i>p</i> )	Within <i>Q</i> ( <i>p</i> )	Total <i>Q</i> ( <i>p</i> )	Effect Size <i>Z</i>	<i>p</i>
<i>Three Major Constructs</i>	1686.2958 (.0000)	860.9140 (.0000)	2547.2098 (.0000)		
Cohesion				20.8600	.0000
Knowledge				41.3782	.0000
Environment				-10.1389	.0000
<i>Seven Sub-Constructs</i>	1742.5705 (.0000)	804.6393 (.0000)	2547.2098 (.0000)		
Cohesion, Collaboration				16.4259	.0000
Cohesion, Modularity				12.9850	.0000
Knowledge Generation				30.5841	.0000
Knowledge Implementation				27.1353	.0000
Knowledge Sharing				8.4583	.0000
Environment, Positive				-3.7763	.0002
Environment, Negative				-10.5086	.0000

**Table 6: Analog ANOVA Results (Maximum Likelihood Mixed Effects Model)**

	Between <i>Q</i> ( <i>p</i> )	Within <i>Q</i> ( <i>p</i> )	Total <i>Q</i> ( <i>p</i> )	Effect Size <i>Z</i>	<i>p</i>
<i>Three Major Constructs</i>	31.9208 (.0000)	65.4680 (.3547)	97.3887 (.0045)		
Cohesion				6.9082	.0000
Knowledge				5.0547	.0000
Environment				-1.8365	.0663
<i>Seven Sub-Constructs</i>	33.0302 (.0000)	65.3867 (.2358)	98.4169 (.0037)		
Cohesion, Collaboration				5.7201	.0000
Cohesion, Modularity				3.9582	.0001
Knowledge Generation				2.8525	.0043
Knowledge Implementation				3.2068	.0013
Knowledge Sharing				2.8284	.0047
Environment, Positive				-1.2065	.2276
Environment, Negative				-1.3993	.1617

**Table 7: Analog ANOVA Results of Knowledge Generation and Implementation vs. Sharing (Mixed Effects)**

	Between <i>Q</i> ( <i>p</i> )	Within <i>Q</i> ( <i>p</i> )	Total <i>Q</i> ( <i>p</i> )	Effect Size <i>Z</i>	<i>p</i>
<i>Knowledge</i>	.5438 (.4609)	26.1945 (.3434)	26.7383 (.3691)		
Generation / Implementation				4.1197	.0000
Sharing				2.7198	.0065

**Table 8: Analog ANOVA Results for Performance Measures**

Between $Q$ ( $p$ )	Within $Q$ ( $p$ )	Total $Q$ ( $p$ )	Overall Mean ES	SE	$Z$	$p$
7.6531 (.0538)	65.0033 (.3391)	72.6565 (.2143)	.2016	.0348	5.7874	.0000
<b>Effect Sizes by Group</b>						
	Mean ES	SE	N	Effect Size $Z$	$p$	
Process	.2407	.0943	9	2.5517	.0107	
Outcome	.2701	.0464	37	5.8157	.0000	
Longevity	.0782	.1268	5	.6164	.5376	
Financial	.0483	.0734	14	.6584	.5103	

**Table 9: Analog ANOVA Results for Industry Studied**

Between $Q$ ( $p$ )	Within $Q$ ( $p$ )	Total $Q$ ( $p$ )	Overall Mean ES	SE	$Z$	$p$
9.0211 (.0290)	64.6109 (.3517)	73.6319 (.1921)	.2016	.0346	5.8257	.0000
<b>Effect Sizes by Group</b>						
	Mean ES	SE	N	Effect Size $Z$	$p$	
High Tech	.0993	.0553	25	1.7944	.0727	
Manufacturing	.2299	.0770	13	2.9844	.0028	
Services	.3838	.0780	13	4.9219	.0000	
Mixed	.1939	.0754	14	2.5705	.0102	

**Table 10: Analog ANOVA Results for Sample Perspective**

Between $Q$ ( $p$ )	Within $Q$ ( $p$ )	Total $Q$ ( $p$ )	Overall Mean ES	SE	$Z$	$p$
3.5883 (.4646)	64.9967 (.3069)	68.5850 (.3247)	.2017	.0359	5.6246	.0000
<b>Effect Sizes by Group</b>						
	Mean ES	SE	N	Effect Size $Z$	$p$	
Buyer	.1860	.0874	11	2.1276	.0334	
Supplier	.3014	.1098	7	2.7459	.0060	
Dyad	.3088	.0915	10	3.3751	.0007	
Mixed	.1191	.0717	16	1.6611	.0967	
Peers	.1898	.0632	21	3.0011	.0027	

**Table 11: Analog ANOVA Results for Alliance Type**

Between $Q$ ( $p$ )	Within $Q$ ( $p$ )	Total $Q$ ( $p$ )	Overall Mean ES	SE	$Z$	$p$
8.7801 (.0324)	64.6442 (.3506)	73.4243 (.1967)	.2016	.0347	5.8175	.0000
<b>Effect Sizes by Group</b>						
	Mean ES	SE	N	Effect Size $Z$	$p$	
Joint venture	.1680	.0425	43	3.9491	.0001	
Partnership	-.0119	.1605	3	-.0742	.9408	
Collaboration	.5415	.1398	4	3.8736	.0001	
Mixed	.2515	.0725	15	3.4667	.0005	

**Table 12: Analog ANOVA Results for Study Specification**

Between $Q$ ( $p$ )	Within $Q$ ( $p$ )	Total $Q$ ( $p$ )	Overall Mean ES	SE	$Z$	$p$
8.2923 (.0158)	64.5427 (.3878)	72.8350 (.2101)	.2016	.0348	5.7944	.0000
Effect Sizes by Group		Mean ES	SE	N	Effect Size $Z$	$p$
Alliance formation		.1199	.0799	12	1.4995	.1337
On-going alliance		.2928	.0473	35	6.1928	.0000
New product		.0756	.0671	18	1.1262	.2601

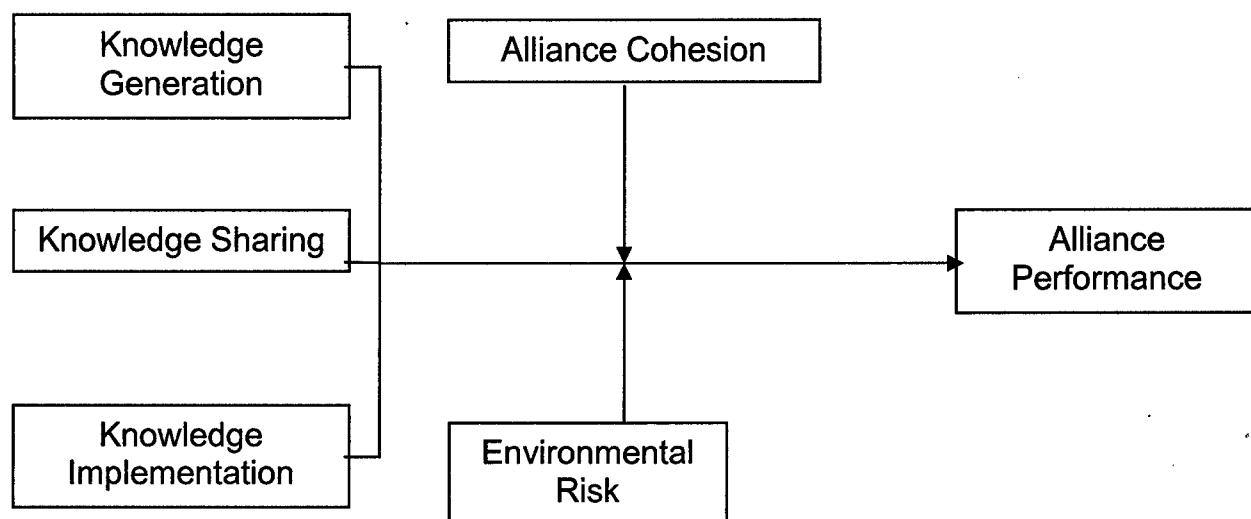
**Table 13: Meta-Analytic Regression Results for Study Differences (with Constructs)**

Model $Q$ ( $p$ )	Residual $Q$ ( $p$ )	Total $Q$ ( $p$ )	$R^2$	N		
35.5363 (.0000)	64.4953 (.3554)	101.0316 (.0022)	.3616	65		
Regression Coefficients		B	SE	$Z$	$p$	Beta
Constant		.2504	.0667	3.7563	.0002	.0000
Model Construct		-.0717	.0143	-5.0218	.0000	-.5054
Industry		.1447	.0613	2.3592	.0183	.2380
Alliance type		.1449	.0632	2.2931	.0218	.2304

**Table 14: Meta-Analytic Regression Results for Study Differences (without Constructs)**

Model $Q$ ( $p$ )	Residual $Q$ ( $p$ )	Total $Q$ ( $p$ )	$R^2$	N		
8.2254 (.0164)	64.6801 (.3832)	72.9055 (.2085)	.1128	65		
Regression Coefficients		B	SE	$Z$	$p$	Beta
Constant		.0505	.0631	.8000	.4237	.0000
Industry		.1812	.0717	2.5258	.0115	.2977
Alliance type		.1211	.0741	1.6352	.1020	.1927

**Figure 1: Proposed Model**





**Appendix: Articles Meta-Analyzed**

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